

Minimizing Ports During Robotic Partial Nephrectomy

Omer Burak Argun, MD, Panagiotis Mourmouris, MD, Ilter Tufek, MD, Can Obek, MD, Mustafa Bilal Tuna, MD, Selcuk Keskin, MD, Ali Riza Kural

ABSTRACT

Background and Objective: Robotic upper urinary tract surgery is in most of the cases performed utilizing a standard 5 port configuration. Fewer ports can potentially produce a less invasive operation. Taking in consideration the above we report a novel technique for robot assisted laparoscopic partial nephrectomy utilizing fewer ports and we test its feasibility and safety profile.

Methods: Data on 11 robot-assisted laparoscopic partial nephrectomies performed by using our technique from February 2015 through June 2015 were retrospectively analyzed. The robotic platform used was DaVinci Xi (Intuitive Surgical, Inc., Sunnyvale, California, USA) with a 3-arm setup. The AirSeal system (SurgiQuest, Milford, Connecticut, USA) was used as a port allowing simultaneous introduction of 2 instruments for the bedside surgeon, obviating the need for an additional (fourth) robotic arm. A long suction-and-irrigation device and atraumatic grasping forceps were used. Both instruments were introduced through the trocar of the AirSeal system, making simultaneous introduction and use possible. We preferred the long suction-and-irrigation device, because it minimizes collision of the instruments.

Results: Mean age and BMI of the patients were 55 ± 14.6 y and 29.18 ± 6.85 , respectively. Seven tumors were on the right side and 4 were on the left. The mean size of the tumors was 32.45 mm (± 11.31). Surgical time was 132.2 minutes (± 37.17), with an estimated blood loss and ischemia time of 103.63 mL (± 65.92) and 16.72 minutes (± 9.52), respectively. One patient had postoperative bleeding that was resolved without transfusion. The median hospitalization period was 3.9 d (± 0.53). Loss of

intra-abdominal pressure was not observed, and pressure was stable at 10 mm Hg.

Conclusion: The AirSeal System and its valveless trocar eliminated the need for an additional port placement in our series. The technique is feasible, safe, and reproducible; therefore, it may be implemented in selected cases of robot-assisted partial nephrectomies.

Key Words: Port placement, Renal cancer, Robotic partial nephrectomy.

INTRODUCTION

Since the introduction of laparoscopy, surgeons have been intrigued by the idea of reduced port placement and smaller scars for their patients. The potential gain for the patient would be decreased postoperative pain. A decreased number of incisions would also facilitate postoperative recovery.¹ It was thus inevitable for surgeons performing robot-assisted laparoscopic operations to attempt to attain that goal, and single-port surgery was born. Nevertheless, robotic single-port surgery requires the use of a novel robotic platform² which increases cost and still needs to prove its efficacy and safety. In the following, we describe a novel technique, in which both bedside surgical instruments are introduced simultaneously through the Valveless AirSeal System trocar (SurgiQuest, Milford Connecticut, USA). This novel technique may provide a substitute for the 5-port configuration classically used during robot-assisted laparoscopic surgery on the upper urinary tract.

MATERIALS AND METHODS

From February 2015 through June 2015, 11 robot-assisted laparoscopic partial nephrectomies were performed with this novel technique. The patient was positioned in a modified flank position with the diseased side up and then flexed using the table break at the level of anterior superior iliac crest. The outward-facing arm was tucked to the side. The robotic platform used was DaVinci Xi (Intuitive Surgical Inc., Sunnyvale, California, USA) with a 3-arm setup for all surgical cases. Pneumoperitoneum was

Department of Urology, Acibadem University, Istanbul, Turkey (Drs Argun, Mourmouris, Tufek, Keskin, Kural); Taksim Acibadem Hospital, Department of Urology, Istanbul, Turkey (Dr Obek); Department of Urology, Aile Hospital, Istanbul, Turkey (Dr Tuna).

Address correspondence to: Panagiotis Mourmouris, Buyukdere Cad 40 Maslak 34457 Istanbul, Turkey; Telephone: 0030 694 7564319, Fax: 0090 212 2866131, E-mail: thodoros13@yahoo.com

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established with a Veress needle. The port setup used is depicted in **Figure 1**. An 8-mm port was placed 3 cm lateral to the umbilicus. Two additional 8-mm ports were placed under endoscopic guidance. The first one was placed lateral to the rectus sheath and 8 cm cranial to the camera port. The second one was placed caudal to the camera port on the same line. A 12-mm assistant port was placed on the midline, 5 cm cranial to the umbilicus. A suction device and the grasping forceps were both used through the AirSeal system trocar, either alone or simultaneously in all cases, obviating the need for an additional trocar for the fourth robotic arm. A long suction-and-irrigation device was preferred, to minimize instrument collision with the atraumatic grasping forceps (**Figure 2, 3**).

RESULTS

Patient characteristics are shown on **Table 1**. Of the 11 patients enrolled in the study, 8 were male and 3 female. Mean age and body mass index (BMI) of the patients was 55 y (± 14.6) and 29.2 (± 6.85), respectively. Seven of them had right side tumors and 4 had left side. The mean size of the tumor was 32.4 mm (± 11.31). Operative time was 132.2 minutes (± 37.17) with an estimated blood loss and ischemia time of 103.6 mL (± 65.92) and 16.7 minutes (± 9.52), respectively. One patient had postoperative bleeding that resolved without transfusion. The median hospitalization period was 3.9 d (± 0.53). Intra- and post-operative characteristics are summarized in **Table 2**. All operations were completed without the need for additional port placement. Intra-abdominal pressure did not

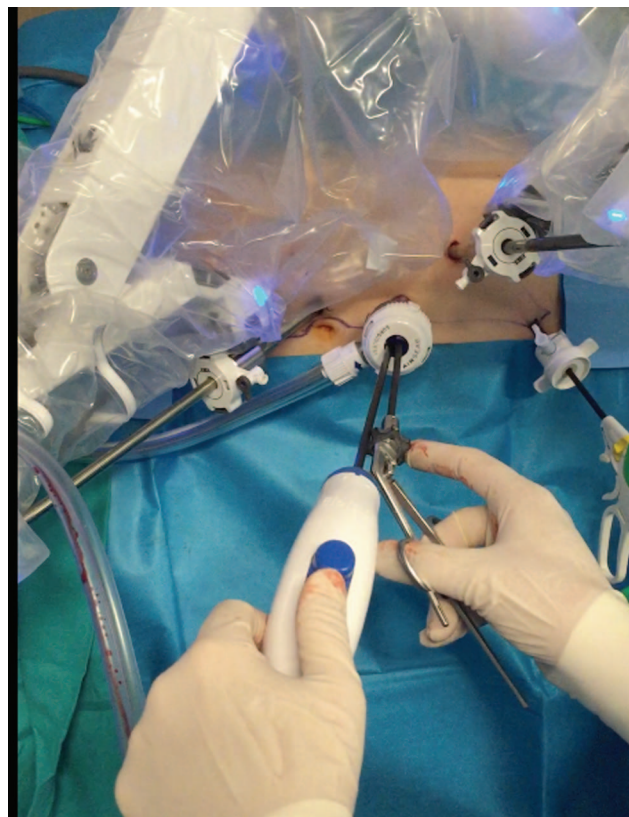


Figure 2. Intracorporeal view of both instruments used during robotic partial nephrectomy.

decrease by passing the instruments through the AirSeal trocar and was stable at 10 mm Hg.

DISCUSSION

The surgical experience with laparoscopy increased over time, and one of the new goals of laparoscopic surgery became to accomplish the same good results through fewer ports and incisions. This challenge led to the establishment of the laparoendoscopic single-site surgery (LESS), in which a novel multichannel access system is used that allows for simultaneous passage of several laparoscopic instruments through 1 incision. The size of the fascial incision is determined by the number and size of instruments that the port can accommodate and varies, depending on the specific operative indication.⁵ Even though this technique is promising and its results are not inferior to standard laparoscopic surgery, its main advantage remains limited to improved cosmetic results. Challenging ergonomics and instrument clashing make this technique demanding, even for the experienced laparoscopic surgeon.⁶

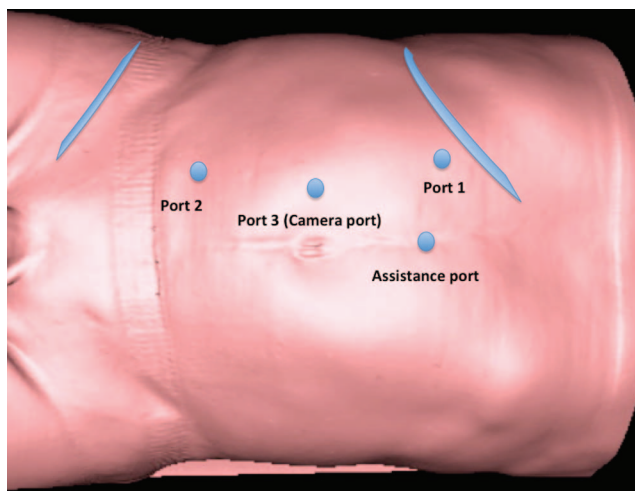


Figure 1. Extracorporeal view of insertion of both instruments through an AirSeal trocar.

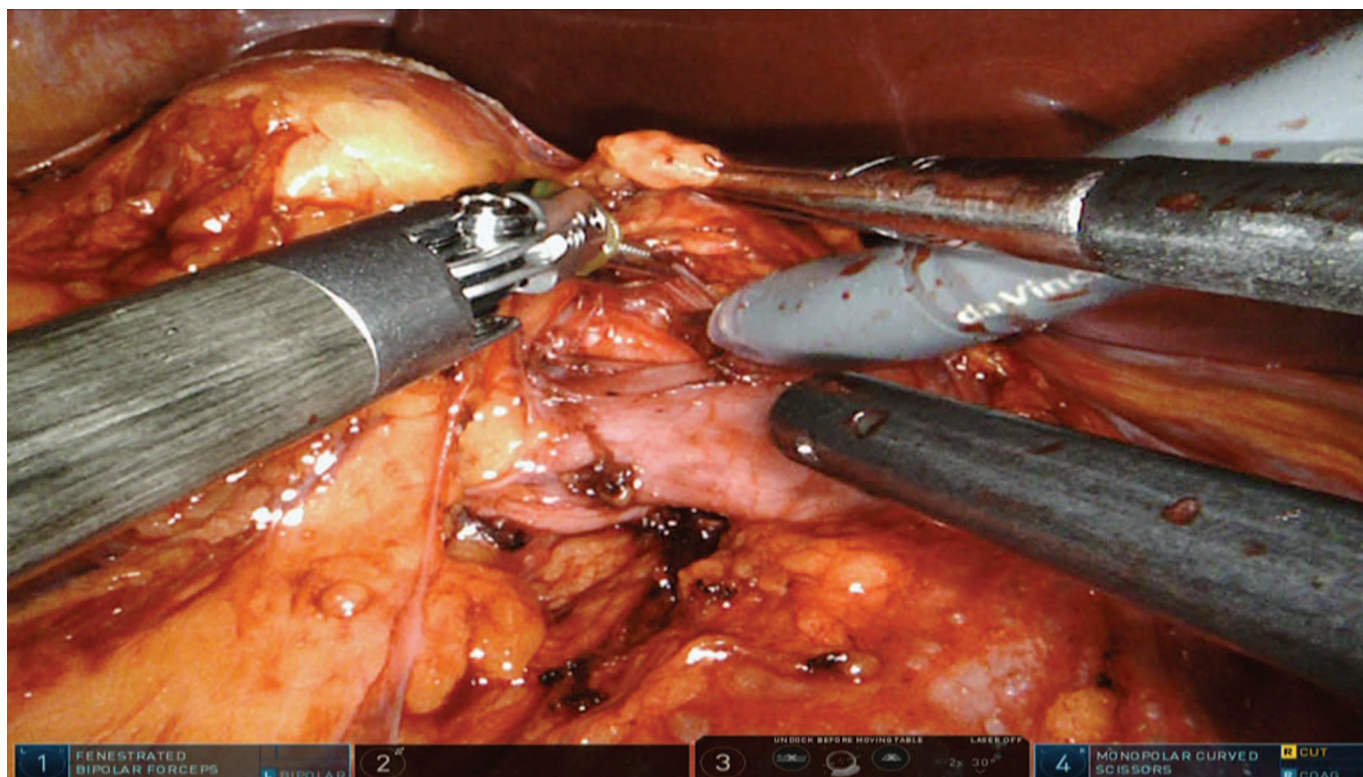


Figure 3. There was no decrease in intra-abdominal pressure during insertion of both instruments through the AirSeal trocar.

Table 1.
Patient Characteristics

Patient	Gender	Age (y)	BMI (kg/m ²)	Size (mm)	Side	Tumor Location
1	M	38	24	20	L	Lower pole
2	M	62	27	25	L	Lower pole
3	F	69	25	45	L	Lower pole
4	M	51	24	40	L	Lower pole
5	M	26	30	27	L	Lower pole
6	F	65	25	24	R	Middle
7	M	70	36	22	R	Middle
8	M	49	46	50	L	Lower pole posterolateral
9	M	68	32	42	R	Middle
10	M	43	23	42	L	Lower pole
11	F	64	29	20	R	Middle

L, left; R, right.

Robotic technology responded to this demand with a newly modified surgical platform developed to fulfill the need of robotic (R)LESS procedures. Results of the initial experience with this system were promising, but its safety and its feasibility are yet to be established.^{7,8} R-LESS procedures require a new robotic surgical system and novel instruments, further increasing cost. There are no clear proven major advantages over the conventional robotic procedures, at least up to date.

Minimizing the number of ports during robot-assisted partial nephrectomy could be advantageous. One less incision could potentially decrease postoperative pain (even though proving this assumption would be challenging) and provide slightly improved cosmesis. Elimination of the use of one robotic arm would reduce the expenditure. Inspired by this notion, we developed a technique that uses 4 ports only (3 robotic and 1 assistant). From the assistant port, we were able to insert 2 instruments simultaneously with minimal collision. The role of the fourth robotic arm is to assist during renal hilar dissection and manipulation of the kidney during tumor resection. In the present technique, the assistant managed to help the console surgeon successfully during these steps of the proce-

Table 2.
Intra- and Postoperative Characteristics

Patient	Surgical Time (min)	Estimated Blood Loss (mL)	Warm Ischemia Time (min)	Surgical Margins	Hospitalization Time (d)	Drain Removal (d)	Foley Removal (d)
1	120	50	30	Negative	4	2	1
2	75	200	22	Negative	3	1	1
3	135	40	26	Negative	3	2	1
4	180	50	19	Negative	4	2	1
5	145	150	17	Negative	4	2	1
6	90	50	0	Negative	4	2	1
7	105	50	13	Negative	4	2	1
8	165	200	15	Negative	4	3	4
9	185	150	0	Negative	5	3	2
10	100	150	21	Negative	4	3	1
11	155	50	21	Negative	4	2	1

cedure, and hence the requirement for the fourth robotic arm was obviated. Moreover, this part of the procedure was accomplished with acceptable instrument collision. Use of a long suction device was the key to preventing instruments from clashing as they passed through the same port. An interesting observation with the 4-port technique was that pneumoperitoneum was always stable, even with two 5-mm instruments inside the AirSeal trocar. Although one 10-mm instrument through the AirSeal port compromises pneumoperitoneum, simultaneous introduction of two 5-mm instruments did not have the same impact. Thus, 2 instruments could be used simultaneously for retraction and suction.

Our median operative time of 132 minutes and warm ischemia time of 16.72 minutes are parallel to those reported in the literature (surgical time, 83–265 minutes; warm ischemia time, 21–31 minutes).⁹ The present technique was not associated with any complication (Clavien-Dindo grade ≥ 2), proving it to be potentially safe. It would appear to be easily reproducible, because it involves the standard triangular placement of the ports, an arrangement familiar to most upper urinary tract surgeons.

We acknowledge that there are some limitations to our study. First of all, the series included too few cases to draw definite conclusions. There were no upper pole tumors among the 11 patients; surgical excision of an upper pole kidney tumor may require an additional fourth robotic arm. This technique is also associated with some compromise of the console surgeon's autonomy, because he controls one less robotic arm. Finally, no pain score was recorded,

and hence no conclusion may be drawn about the potential positive impact of fewer ports on postoperative pain.

The goal of this study was mainly to assess the feasibility and safety profile of this technique. Further studies comparing results with the standard 5-port approach would be necessary to prove whether it has any clinical advantages.

CONCLUSION

Reducing the number of ports by using the suction device and grasping forceps through the AirSeal System and its valveless trocar may provide a substitute for the 5-port configuration normally used during robot-assisted laparoscopic surgery on the upper urinary tract. The technique appears to be feasible and safe and thus may be used in selected cases of robotic-assisted partial nephrectomy.

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